WATER RESOURCES REVIEW for

JANUARY

1974

UNITED STATES
DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY

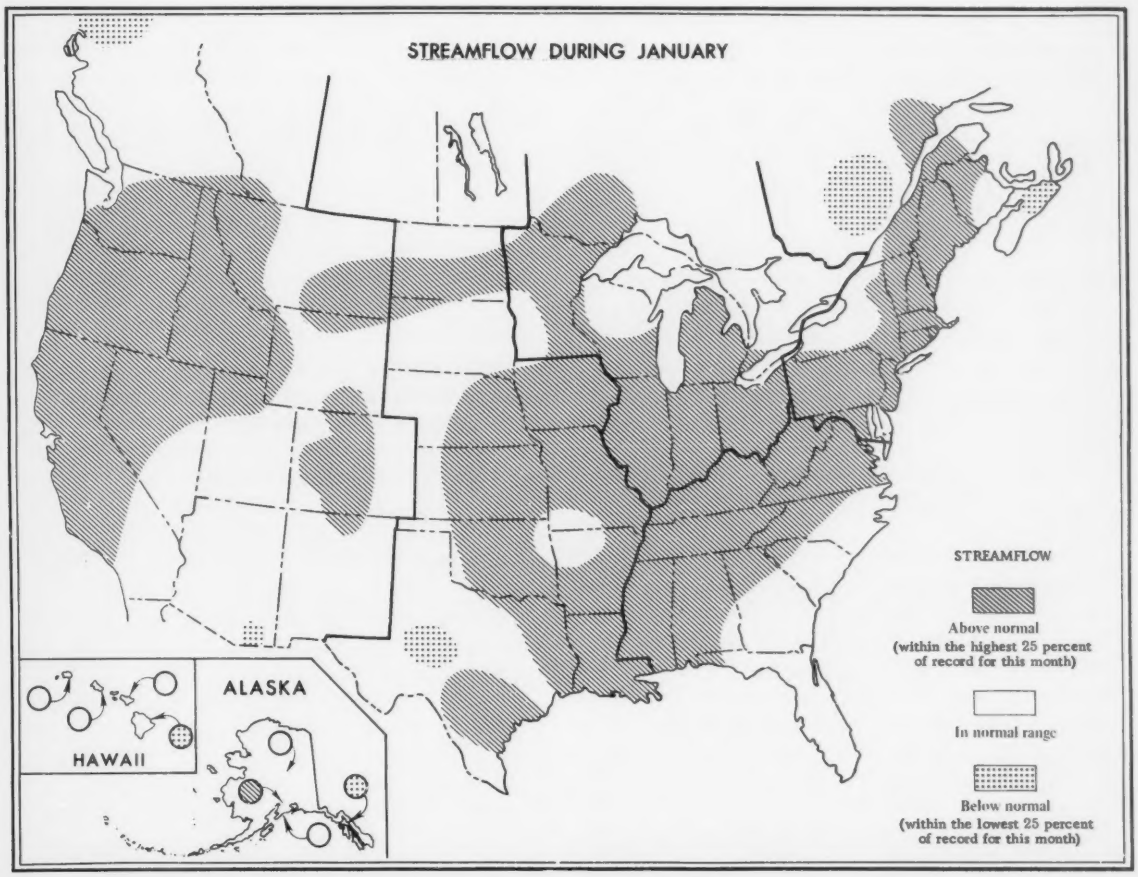
CANADA
DEPARTMENT OF THE ENVIRONMENT
WATER RESOURCES BRANCH

STREAMFLOW AND GROUND–WATER CONDITIONS

Streamflow increased in most parts of the United States but generally decreased in Alaska and Hawaii, and in the southern parts of the Canadian Provinces.

Above-normal flows persisted for the third consecutive month in large areas in the eastern, central, and western parts of the United States. Flow of Mississippi River at Baton Rouge, Louisiana, was highest for January since records began in 1928. Flows were below normal in small areas of British Columbia, Quebec, Nova Scotia, Arizona, and Texas.

Flooding occurred in parts of fourteen States, including North Carolina, Mississippi, and Tennessee, in the Southeast; Indiana, Michigan, and Ohio, in the Western Great Lakes region; Kansas, Louisiana, and Missouri, in the Midcontinent; and California, Idaho, Montana, Oregon, and Washington, in the West.



CONTENTS OF THIS ISSUE: Northeast, Southeast, Western Great Lakes region, Midcontinent, West, Alaska, Hawaii; Hydrographs of four large rivers; Basic data reports on quality of surface water; Usable contents of selected reservoirs near end of January 1974; Flow of large rivers during January 1974; Use of finite-difference arrays of observation wells to estimate evapotranspiration from ground water in the Arkansas River valley, Colorado.

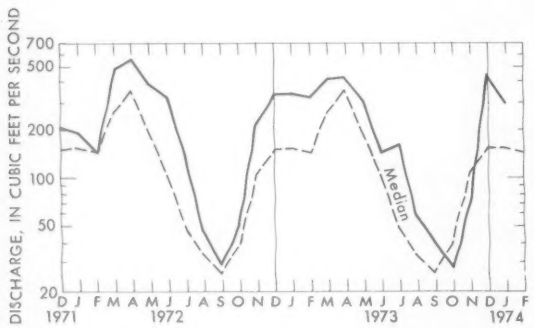
NORTHEAST

[Atlantic Provinces and Quebec; Delaware, Maryland, New York, New Jersey, Pennsylvania, and the New England States]

STREAMFLOW GENERALLY DECREASED FROM THE HIGH FLOWS OF DECEMBER BUT REMAINED IN THE ABOVE-NORMAL RANGE AT MOST INDEX STATIONS IN THE REGION. FLOWS DECREASED INTO THE BELOW-NORMAL RANGE IN PARTS OF NOVA SCOTIA AND QUEBEC.

High carryover flows from December, supplemented by runoff from snowmelt and rain in the last half of the month, held monthly mean flows well above January medians and above the normal range in parts of all Provinces and States of the region except Nova Scotia.

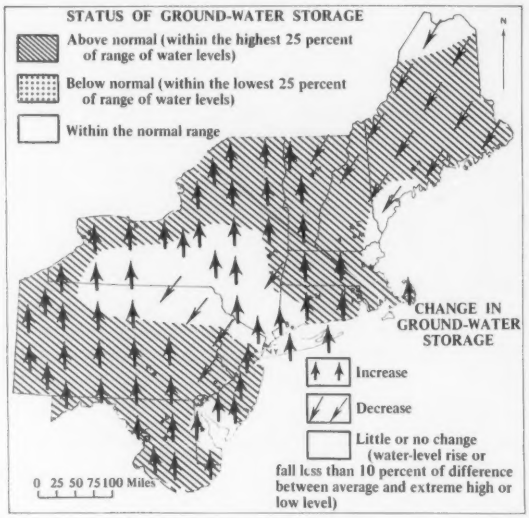
Flows in north-central New Brunswick, and at all index stations in the six New England States decreased, but were nearly double the median flows for the month. Cumulative runoff in those areas during the two-month period, December through January, also was nearly double the median. Flow of Ware River at Coldbrook, Mass., was generally typical of the pattern at many index stations in the region (see graph).



Monthly mean discharge of Ware River at Coldbrook, Mass. *(Drainage area, 96.8 square miles.)*

Similarly, in the southern part of the region, flows of Delaware River at Trenton, N.J., and Susquehanna River at Harrisburg, Pa., decreased from their unusually high flows of December, remained above the normal range, and were nearly twice the median flow for January. Near Washington, D.C., flow of Potomac River increased seasonally and remained in the above-normal range. Cumulative runoff at this site for the first four months of the current water year was more than double the median for that period.

Ground-water levels generally declined in Maine, New Hampshire, and eastern Pennsylvania; and rose in most other parts of the region. Monthend levels remained above normal in most of New England and were above normal also in Maryland and large areas in New Jersey, New York, and Pennsylvania (see map). In some parts of New England, levels were highest for end-of-January in at least 20 years.


STATUS OF GROUND-WATER STORAGE
Above normal (within the highest 25 percent of range of water levels)
Below normal (within the lowest 25 percent of range of water levels)
Within the normal range
N
CHANGE IN GROUND-WATER STORAGE
Increase
Decrease
Little or no change (water-level rise or fall less than 10 percent of difference between average and extreme high or low level)
0 25 50 75 100 Miles

Map shows ground-water storage near end of January and change in ground-water storage from end of December to end of January.

SOUTHEAST

[Alabama, Florida, Georgia, Kentucky, Mississippi, North Carolina, South Carolina, Tennessee, Virginia, and West Virginia]

STREAMFLOW INCREASED AND WAS ABOVE THE NORMAL RANGE IN MUCH OF THE REGION BUT DECREASED FROM THE UNUSUALLY HIGH FLOWS OF DECEMBER IN PARTS OF VIRGINIA AND WEST VIRGINIA. FLOODING OCCURRED ON SOME STREAMS IN MISSISSIPPI, IN WESTERN NORTH CAROLINA, AND IN THE NORTH-CENTRAL AND WESTERN PARTS OF TENNESSEE.

Monthly mean flows were 2 to 5 times the January medians at many index stations on streams in the western part of the region.

In south-central Mississippi, the mean discharge of 24,600 cfs on Big Black River near Bovina (drainage area, 2,810 square miles) was the highest for any month since records began in 1936 and about 5 times the January median. Cumulative runoff since October 1, 1973 at that site was more than 4 times median runoff for the 4-month period, October through January. In the southeastern part of the State, the mean flow of 38,520

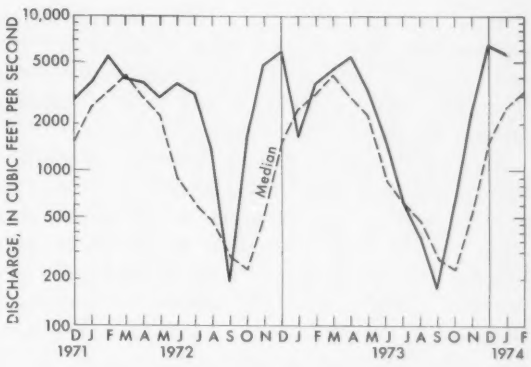
cfs on Pascagoula River at Merrill (drainage area, 6,600 square miles) was highest for January in 43 years of record and more than 3 times the January median flow. At monthend the larger rivers in the State were above flood stage. For example, monthend stages of Pearl River at Columbia and Jackson, in southern Mississippi, were highest of record since 1961 and 1969, respectively. In the northwestern part of the State, rising floodwaters of Tallahatchie River forced evacuation of the community of Phillips. Nearby to the south, flooding was widespread in the Yazoo Delta; flood-control reservoirs in the Yazoo River basin were nearly full. At Vicksburg, in the west-central part of the State, monthend stage of the Mississippi River was higher than at the end of January 1973, and the nearby community of Long Lake was being evacuated. The Corps of Engineers has expressed concern regarding the possibility of another great Mississippi River flood this spring.

In Tennessee, monthly mean flows at all index stations remained in the above-normal range, where they have been in 7 of the past 11 months. Rainfall over the State was about double the January normal, except in the central Cumberland River basin in north-central Tennessee, and was evenly distributed throughout the month, causing only minor lowland flooding. In the central Cumberland River basin, rains of 4 to 6 inches January 9 to 11, caused severe flooding on the Cumberland River and its larger tributaries. Also, some flooding occurred in the lowlands along the Mississippi River in extreme western Tennessee, caused by concurrent high Mississippi River stages and high tributary inflow.

In northern Georgia, flow of Oostanaula River at Resaca increased sharply and was almost 4 times the January median. Cumulative runoff, October through January, was nearly 3 times median for that 4-month period. By contrast, in southern Georgia, cumulative runoff of Alapaha River at Statenville was only 76 percent of median during the same period.

Streamflow in Kentucky generally was above the normal range and more than double the median for the month. Similarly, the monthly mean flow of 328,100 cfs on Ohio River at Louisville, Ky., representing runoff from 91,170 square miles in east-central United States, was more than twice the January median and in the above-normal range.

In Virginia and West Virginia, flows increased at some index stations and decreased at others, but remained in the above-normal range. Minor flooding occurred along Greenbrier River in eastern West Virginia as a result of heavy rains January 10–12, and the monthly mean discharge at Alderson remained above the normal range for the 4th consecutive month (see graph). Cumulative runoff at that station during the 4-month period was more than twice the median.



Monthly mean discharge of Greenbrier River at Alderson, W. Va. (Drainage area, 1,357 square miles.)

In extreme northwestern Florida, the monthly mean flow of 2,440 cfs on Shoal River near Crestview (drainage area, 474 square miles) was 3 times the January median and highest for the month since records began in 1938. Flow of Silver Springs, in north-central Florida, decreased 75 cfs, to 645 cfs; 86 percent of normal. In southwestern Florida, flow southward through the Tamiami canal outlets, 40-mile bend to Monroe, decreased 5.5 cfs, to 14.5 cfs; 42 percent of normal, and in the southeast, flow of Miami canal at Miami decreased 5 cfs, to 154 cfs; 54 percent of normal.

Ground-water levels rose in most of the region as a result of recharge from rainfall, heavy in some areas. However, levels remained about the same in northern Florida; and generally declined in southeastern Florida and extreme southern West Virginia as well as in some of the heavily pumped Coastal Plain areas of eastern North Carolina. Monthend levels were generally above average in Kentucky, West Virginia, North Carolina, and Georgia; near average in southeastern Florida, and below average in northern Florida.

WESTERN GREAT LAKES REGION

[Ontario; Illinois, Indiana, Michigan, Minnesota, Ohio, and Wisconsin]

STREAMFLOW GENERALLY INCREASED IN THE SOUTHERN PART OF THE REGION, DECREASED IN THE NORTH, AND WAS ABOVE THE NORMAL RANGE EXCEPT IN EASTERN ONTARIO AND NORTHERN WISCONSIN. FLOWS RANGED FROM ABOUT 3 TO MORE THAN 6 TIMES THE MEDIANS FOR JANUARY IN PARTS OF MINNESOTA, ILLINOIS, INDIANA, OHIO, AND MICHIGAN.

MINOR FLOODING OCCURRED IN PARTS OF INDIANA, MICHIGAN, AND OHIO.

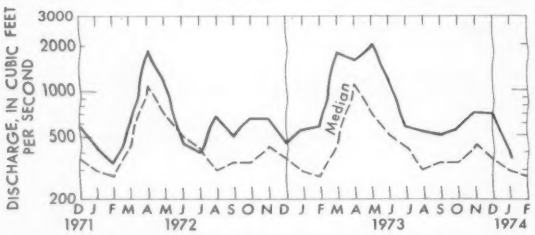
Flows increased seasonally in Ohio, Indiana, Illinois, and southern Michigan, as a result of runoff from rain and snowmelt, and decreased seasonally in Minnesota, Wisconsin, northern Michigan, and most of southern Ontario, as a result of below-normal temperatures.

Flow of Pecatonica River at Freeport, in northern Illinois, increased sharply, was more than 3 times the January median, and remained in the above-normal range for the 18th consecutive month. In southern Illinois, flow of Sangamon River at Monticello also increased sharply, from 105 percent of median in December to 495 percent of median in January. Flow at that index station was in the normal range during the four preceeding months.

In Minnesota, monthly mean flows at the index stations, Buffalo River near Dilworth and Crow River at Rockford, remained in the above-normal range for the 5th consecutive month. Cumulative runoff at Rockford for the 4-month period ending in January was about 14 times the median cumulative runoff for that period, the first third of the current water year. Flows of Minnesota River at Jordan and Mississippi River at St. Paul remained above the normal range for the 4th consecutive month.

Above-normal temperatures, accompanied by rains, resulted in sharp increases in flow and minor flooding along some streams in northern Ohio, southern Michigan, and parts of Indiana. Monthly mean flows at index stations on Mississinewa River, in northern Indiana, and Red Cedar River, in southern Michigan, were about 4 and 6 times their respective January medians.

In northern Wisconsin, monthly mean flow of Oconto River near Gillett decreased and was in the normal range for the first time in 13 months (see graph).



Monthly mean discharge of Oconto River near Gillett, Wis. (Drainage area, 678 square miles.)

Ground-water levels rose in most wells in Indiana, Ohio, and southern Michigan; and declined in Minnesota and northern Michigan. Monthend levels were generally below average in southern Minnesota; and above average in northern Minnesota and throughout Indiana, Ohio, and Michigan. Levels in wells tapping artesian aquifers underlying the Minneapolis-St. Paul, Minn., area, rose slightly but remained below average.

MIDCONTINENT

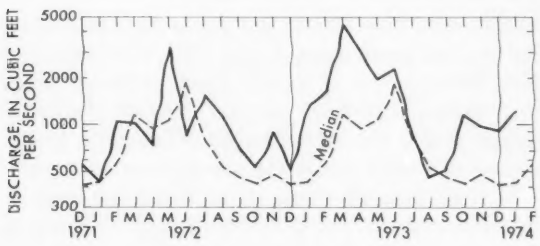
[Manitoba and Saskatchewan; Arkansas, Iowa, Kansas, Louisiana, Missouri, Nebraska, North Dakota, Oklahoma, South Dakota, and Texas]

STREAMFLOW INCREASED IN LOUISIANA, KANSAS, NEBRASKA, AND PARTS OF TEXAS, MISSOURI, AND NORTH DAKOTA, AND DECREASED ELSEWHERE IN THE REGION. FLOWS GENERALLY REMAINED ABOVE THE NORMAL RANGE IN THOSE STATES BORDERING THE MISSISSIPPI RIVER AND IN PARTS OF ALL OTHER STATES AND PROVINCES EXCEPT SOUTH DAKOTA AND MANITOBA. MONTHLY MEAN FLOW OF MISSISSIPPI RIVER AT BATON ROUGE, LOUISIANA, WAS HIGHEST FOR JANUARY SINCE RECORDS BEGAN IN 1928. FLOODING OCCURRED IN PARTS OF KANSAS, MISSOURI, AND LOUISIANA.

The monthend flow of 1,200,000 cfs on Mississippi River at Baton Rouge, Louisiana, was 500,000 cfs greater than the monthend flow of January 1973, and the monthend stage at that point was higher than the end-of-January stages in the historic flood years of 1927 and 1973. Monthly mean flow of Atchafalaya River, the principal distributary for the lower Mississippi River system, was highest for January in record that began in 1935. In northern Louisiana, the level of Ouachita River at Monroe reached the designated flood stage of 40 feet on January 13 and continued to rise through the remainder of the month. Moderate flooding occurred on most other streams in the State as a result of persistent rain that fell on more than half the days of the month. About 20 families were evacuated from the Black River flood plain near Jonesville, in northeastern Louisiana, and that river continued to rise at monthend. In the southeast, the monthly mean discharge of 48,500 cfs on Pearl River near Bogalusa (drainage area, 6,630 square miles) was highest for any month in record that began October 1938, and more than 4 times the January median flow. Mean flows at other index stations in the State ranged from about 3 to 5 times median for the month. In the northwest part of the State, the mean flow of 1,167 cfs on Saline Bayou near Lucky was highest for January in 33 years of record and more than 5 times the January median.

In Kansas, streamflow generally remained in the above-normal range for the 5th consecutive month. At the index station, Saline River near Russell (drainage area, 1,502 square miles) the monthly mean discharge of 197 cfs, and the daily mean of 575 cfs on the 21st, were highest for January in 22 years of record. Cumulative runoff at this station during the first 4 months of the 1974 water year was about 11 times the median runoff for that period. In north-central Kansas, and adjacent south-central Nebraska, cumulative runoff of Little Blue River, as measured at Barnes, Kansas, for the same 4-month period, was more than 13 times the median. Extensive flooding, caused by ice jams, occurred along the lower reaches of Kansas River in northeastern Kansas during the latter part of the month.

In northeastern Nebraska, the mean flow of Elkhorn River at Waterloo remained above the normal range for the 4th consecutive month, was about 3 times the January median, and only 9 percent less than the maximum monthly mean flow for January in 45 years of record (see graph).



Monthly mean discharge of Elkhorn River at Waterloo, Nebr.
(Drainage area, 6,900 square miles.)

In north-central and southwest Iowa, monthly mean discharges of Winnebago River at Mason City and Nishnabotna River near Hamburg were the highest for January since records began at those two sites in 1933 and 1922, respectively. In the northeastern part of the State, the monthly mean flow of 3,662 cfs on Cedar River at Cedar Rapids (drainage area, 6,510 square miles) was the 5th highest for January since records began in 1902.

High carryover flows from December, plus runoff from snowmelt, resulted in a monthly mean discharge on Cannonball River at Breien, in southwestern North Dakota, that was more than 6 times the January median. Along the eastern border of North Dakota, flow of Red River of the North remained in the above-normal range for the 5th consecutive month.

In Manitoba, flow at the index station, Waterhen River below Waterhen Lake, decreased seasonally and remained in the normal range. The level of Lake Winnipeg at Gimli averaged 714.32 feet above mean sea level, 1.35 feet above the long-term mean for January and 0.18 foot higher than last month.

Ground-water levels generally rose in Iowa and Nebraska; declined slightly in North Dakota; and declined or changed very little in Kansas. In the rice-growing, Grand Prarie area of east-central Arkansas, the level was unchanged in the shallow aquifer (Quaternary deposits) and in same range of January values of past 10 years; and continued to rise seasonally in the deep aquifer (Sparta Sand), though 6-1/2 feet lower than a year ago and lowest of record for end of January. Levels declined at El Dorado and Pine Bluff in the industrial aquifer (Sparta Sand) of central and southern Arkansas. In central Louisiana, levels rose in the terrace aquifers as a result of recharge from the above-average rainfall of the past several months; levels rose also in most other parts of the State. Monthend levels were above average in Iowa and Nebraska (except in areas irrigated by ground water); and were slightly below average in North Dakota. In southwestern Louisiana, although levels continued their seasonal recovery, they were lowest of record (since at least 1940 in the key well) for the end of January. In Texas, levels continued to rise in the Edwards Limestone at Austin and rose also in the bolson deposits at El Paso; levels declined in the Edwards Limestone at San Antonio and in the Evangeline aquifer at Houston. Monthend levels were above average at Austin and San Antonio and below average at Houston and El Paso.

WEST

[Alberta and British Columbia; Arizona, California Colorado, Idaho, Montana, Nevada, New Mexico, Oregon, Utah, Washington, and Wyoming]

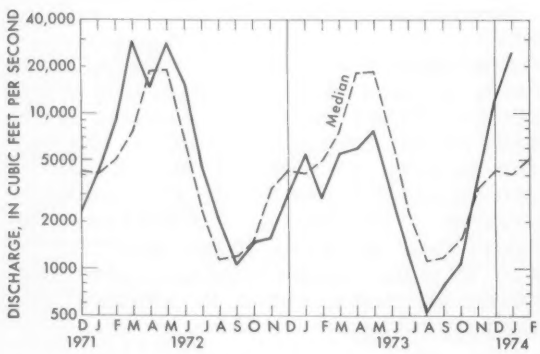
STREAMFLOW GENERALLY INCREASED IN PARTS OF ALL PROVINCES AND STATES IN THE REGION EXCEPT BRITISH COLUMBIA. FLOWS WERE ABOVE THE NORMAL RANGE IN MUCH OF THE WESTERN HALF OF THE REGION, AND IN TWO SMALLER AREAS IN THE EASTERN HALF. EXTREME FLOODING OCCURRED IN CALIFORNIA, MONTANA, IDAHO, WASHINGTON, AND OREGON. BELOW-NORMAL FLOWS PERSISTED IN SMALL AREAS IN ARIZONA AND BRITISH COLUMBIA.

Record, or near-record, flood stages and discharges occurred on many streams in California and the four northwestern States of the region January 15–22 as a result of runoff from heavy rains, and snowmelt at altitudes as high as about 6,000 feet in parts of Idaho and about 8,000 feet in some basins of western Montana.

Below-normal temperatures and above-normal snowfall occurred during the early part of the month and preceded the chinook winds and the sharp rise in temperatures that moved across the area January 13. The heavy rains that accompanied and followed these warm winds, augmented the snowmelt runoff. Record-high temperatures occurred at many points. Selected data on stages, discharges, and gaging station locations are given on the accompanying table and map.

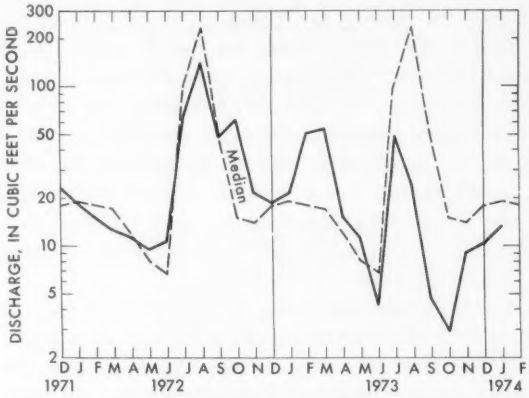
In addition to the record-breaking flood-peak discharges, many of which may recur, on the average, only once in 100 years or more, record-high monthly or daily mean discharges for January occurred on streams in Idaho, Montana, and Washington.

In northern Idaho, monthly mean discharges were highest of record for January in Coeur d' Alene and Salmon River basins. At the index station, Salmon River at White Bird (drainage area, 13,350 square miles) the monthly mean discharge of 9,297 cfs and the daily mean of 29,400 cfs on the 17th, were highest for the month in 61 years of record. In western Montana, the daily mean discharge of 28,000 cfs on January 17, at the index station, Clark Fork at St. Regis (drainage area, 10,709 square miles) was highest for January in 57 years of record of daily discharges. In south-central Montana, the daily mean of 6,460 cfs on the 18th on Yellowstone River at Billings (drainage area, 11,795 square miles) was highest for the month in 48 years of record. In eastern Washington, and the adjacent area of northern Idaho, the monthly mean discharge of 23,800 cfs on Spokane River, as measured at Spokane, Washington (drainage area, 4,290 square miles) was highest for the month in record that began in April 1891, and was almost 6 times the median for January (see graph).



Monthly mean discharge of Spokane River at Spokane, Wash. (Drainage area, 4,290 square miles.)

In Arizona, where streamflow generally has been below the normal range during the past several months, flows increased and were in the normal range at all index stations except San Pedro River at Charleston, in the extreme southeast, where the monthly mean remained below the normal range for the 7th consecutive month (see graph). Flow also increased in the Gila River basin in



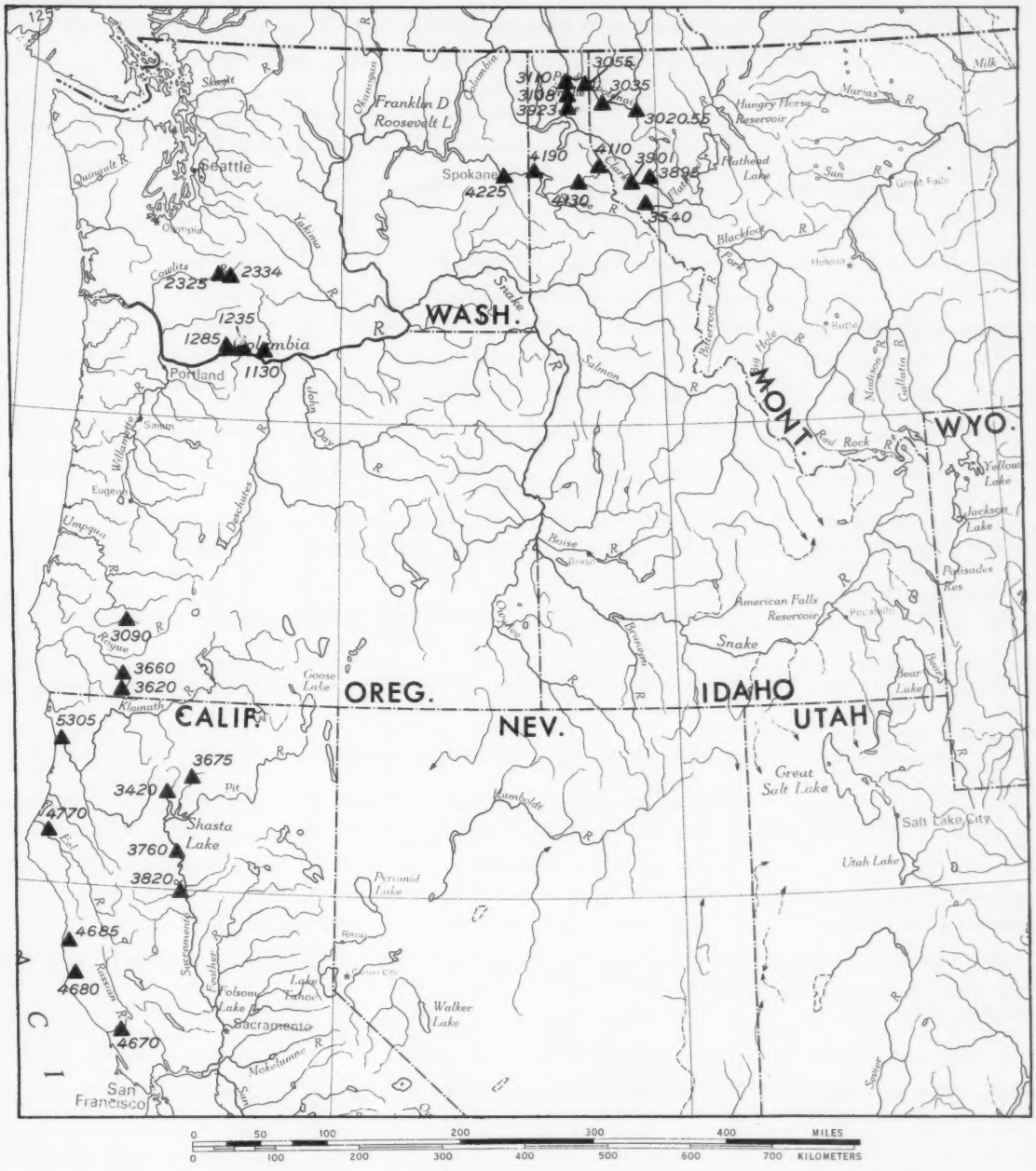
Monthly mean discharge of San Pedro River at Charleston, Ariz. (Drainage area, 1,219 square miles.)

southwestern New Mexico and was in the normal range for the first month since August 1973. In northeastern New Mexico, flow of Rayado Creek at Sauble Ranch near Cimarron increased sharply, from 44 percent of median (below the normal range) in December, to 126 percent of median (above the normal range) in January.

In Utah, streamflow was above the normal range in the north and east, and in the normal range elsewhere in the State. The level of Great Salt Lake rose 0.30 foot during the month (to 4,199.95 feet above mean sea level), 0.90 foot higher than a year ago, and 1.95 feet higher than the average (1904–72) monthly level for January.

Reservoir storage generally increased and was near or above average in the major reservoirs of the region. Inflow to some reservoirs in northern California approached highest rates of record. Storage for hydroelectric power generation in northern Idaho was far above average at monthend.

Ground-water levels generally rose in Washington, Nevada, southern California and New Mexico, and much of southern Arizona, as well as in north-central Utah. Levels generally declined, at least slightly, in Montana, Idaho, and northeastern and southeastern Utah. Monthend levels were above average in Washington (highest for end of January in more than 30 years in key wells in central and eastern part of State), the Boise Valley and eastern Snake River Plain of southern Idaho, most of Nevada other than Truckee Meadows and Las Vegas areas, and southeastern Utah. Levels remained near aver-



Locations of stream-gaging stations described in table of peak stages and discharges on pages 8 and 9.

age in southern California; and were below average in southern Arizona and New Mexico, in northern Utah, and extreme northern Idaho. In southern Arizona, levels were lowest of record for end of January at Elfrida and Willcox, equal to an alltime low at Avra Valley, and at an alltime low at Nogales.

ALASKA

Streamflow decreased seasonally in all parts of the State, and remained below the normal range in the southeast, where the monthly mean discharge of 1.6 cfs, and the daily mean of 0 cfs on the 19th, were the lowest

Provisional data; subject to revision

STAGES AND DISCHARGES FOR THE FLOODS OF JANUARY 1974 AT SELECTED SITES IN CALIFORNIA, MONTANA, IDAHO, WASHINGTON, AND OREGON

WRD station number	Stream and place of determination	Drainage area (square miles)	Period of known floods	Maximum flood previously known			Maximum during present flood				
				Date	Stage (feet)	Discharge (cfs)	Date	Stage (feet)	Discharge		Recurrence interval (years)
									Cfs	Cfs per square mile	
CALIFORNIA											
SACRAMENTO RIVER BASIN											
11-3420	Sacramento River at Delta.	425	1944–	Dec. 22, 1964	20.10	38,800	Jan. 16	27.23	68,000	160	(a)
11-3675	McCloud River near McCloud.	358	1931–	Dec. 21, 1955	9.42	11,800	19	9.3	11,300	31.5	30
11-3760	Cottonwood Creek near Cottonwood.	927	1940–	Dec. 22, 1964	19.64	60,000	16	20.3	[b]60,000	64.7	(a)
11-3820	Thomes Creek at Paskenta.	194	1920–	Dec. 22, 1964	15.32	37,800	16	13.75	30,000	154	30
RUSSIAN RIVER BASIN											
11-4670	Russian River near Guerneville.	1,340	1939–	Dec. 23, 1964	49.6	93,400	16	44.11	73,300	54.7	6
NAVARRO RIVER BASIN											
11-4680	Navarro River near Navarro.	303	1951–	Dec. 22, 1955	[c]40.60	64,500	16	44	80,000	264	25
NOYO RIVER BASIN											
11-4685	Noyo River near Fort Bragg.	106	1952–	Dec. 22, 1964	26.30	24,000	16	27.09	26,000	245	25
EEL RIVER BASIN											
11-4770	Eel River at Scotia	3,113	1910–	Dec. 23, 1964	72.0	752,000	16	52.31	387,000	124	15
KLAMATH RIVER BASIN											
11-5305	Klamath River near Klamath.	12,100	1911–26, 1951–	Dec. 23, 1964	55.3	557,000	16	41.8	436,000	36.0	(a)
MONTANA											
KOOTENAI RIVER BASIN											
12-3020.55	Fisher River near Libby.	838	1967–	May 22, 1948	(a)	6,560	Jan. 22	9.29	8,720	10.4	50+
12-3035	Lake Creek at Troy	210	1945–57	May 30, 1948	8.28	3,250	22	(a)	5,000	23.8	50+
PEND OREILLE RIVER BASIN											
12-3540	St. Regis River near St. Regis.	303	1909–17, 1933, 1954, 1959–	Dec. 20, 1933 May 19, 1954	14.5 9.4	(a) 11,000	22	(a)	10,000	33.0	50+
12-3895	Thompson River near Thompson Falls.	642	1913, 1948, 1956–	May–June 1948	(a)	[d]6,190	22	(a)	4,070	6.33	50+
12-3907	Prospect Creek at Thompson Falls.	182	1956–	May 21, 1956	7.60	2,860	22	(a)	5,450	29.9	50+
IDAHO											
KOOTENAI RIVER BASIN											
12-3055	Boulder Creek near Leonia.	[b]53	1928–	May 30, 1969	5.81	2,720	Jan. 16	7.70	3,600	67.9	100
12-3108	Trail Creek at Naples	[b]16	1961–	. . . . .	. . . . .	. . . . .	15	21.8	1,100	68.8	100+
12-3110	Deep Creek at Moravia . . .	133	1928–	May 18, 1954	7.40	1,670	15	9.1	2,700	20.3	100+
PEND OREILLE RIVER BASIN											
12-3923	Pack River near Colburn.	124	1958–	May 30, 1969	13.69	4,370	15	16.38	6,800	54.8	100+

See footnotes at end of table.

STAGES AND DISCHARGES FOR THE FLOODS OF JANUARY 1974 AT SELECTED SITES IN CALIFORNIA, MONTANA, IDAHO, WASHINGTON, AND OREGON—Continued

WRD station number	Stream and place of determination	Drainage area (square miles)	Period of known floods	Maximum flood previously known			Maximum during present flood				
				Date	Stage (feet)	Discharge (cfs)	Date	Stage (feet)	Discharge		Recurrence interval (years)
									Cfs	Cfs per square mile	
	IDAHO—Continued										
SPOKANE RIVER BASIN											
12-4110	Coeur d'Alene River above Shoshone Creek, near Prichard.	335	1950–	Dec. 23, 1964	8.37	11,900	Jan. 15	11.6	21,500	64.2	100+
12-4130	Coeur d'Alene River at Enaville.	895	1911–13, 1939–	Dec. 23, 1964	77.15	34,800	15	81.35	45,000	50.3	90
12-4190	Spokane River near Post Falls.	3,840	1912–	Dec. 25, 1933	(a)	50,100	19	25.66	45,500	11.8	100+
	WASHINGTON										
SPOKANE RIVER BASIN											
12-4225	Spokane River at Spokane.	4,290	1891–	May 31, 1894	(a)	49,000	Jan. 19	28.9	46,100	10.7	100
KLICKITAT RIVER BASIN											
14-1130	Klickitat River near Pitt.	1,297	1909–12, 1928–	Dec. 23, 1964	14.34	31,100	16	17.12	46,000	35.5	200
WHITE SALMON RIVER BASIN											
14-1235	White Salmon River near Underwood.	386	1916–30, 1936–	Dec. 29, 1917	9.5	9,700	15	12.85	16,000	41.5	200+
WIND RIVER BASIN											
14-1285	Wind River near Carson.	225	1934–	Dec. 23, 1964	19.26	28,300	15	21.91	44,500	198	200
COWLITZ RIVER BASIN											
14-2325	Cispus River near Randle.	321	1911–12, 1930–	Dec. 22, 1933	[c]12.7	20,000	15	12.66	30,000	93.4	500
14-2334	Cowlitz River near Randle.	1,030	1947–	Nov. 24, 1959	[c]19.50	47,500	16	23.54	67,000	65.0	200
	OREGON										
UMPQUA RIVER BASIN											
14-3090	Cow Creek near Azalea.	78.0	1929–31, 1932–	Dec. 22, 1964	15.63	8,430	Jan. 15	16.3	9,200	118	[b]100
ROGUE RIVER BASIN											
14-3620	Applegate River near Copper.	223	1939–	Dec. 22, 1964	26.00	29,000	15	25.42	27,900	125	[b]80
14-3660	Applegate River near Applegate.	483	1938–	Dec. 22, 1964	19.57	45,700	15	20.41	52,000	108	[b]70

[a]Not determined.
[b]Approximately.
[c]Site and datum then in use.
[d]At site 0.2 mile downstream.

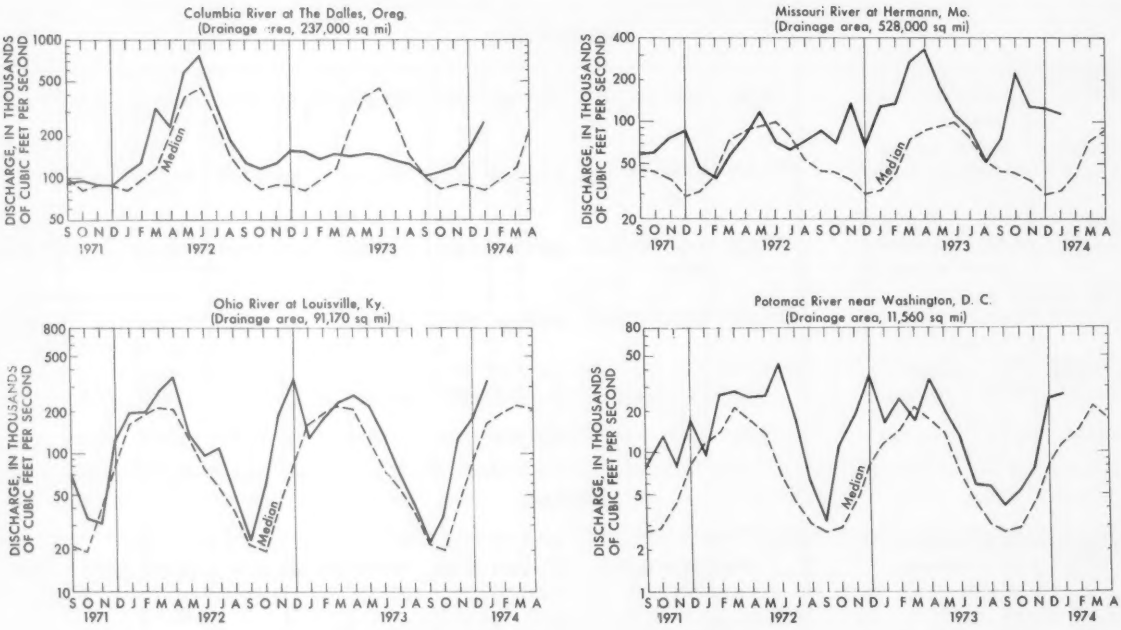
for January in Gold Creek basin near Juneau (drainage area, 9.76 square miles), since records began in October 1964. Decreases in flows in the south-central part of the State were less than normal, because of above-normal temperatures; monthly mean flows were in, or above, the normal range in that area. Monthly mean discharge of 5,439 cfs on Tanana River at Nenana (drainage area, 25,600 square miles) was below the normal range and only 8 percent more than the minimum monthly mean of record. The daily mean discharge of 5,000 cfs on January 31, equalled the lowest daily mean in the 11-year record.

Ground-water levels in water-table wells continued to decline seasonally in the Anchorage area; levels fell slightly in the deeper artesian aquifers, due to pumping.

HAWAII

Streamflow decreased at index stations on the eastern and western islands of the State, and increased on the central island of Oahu. Monthly mean flow of Waiakea Stream near Mountain View, Hawaii, decreased sharply, from 19.4 cfs (158 percent of median) in December, to 3.02 cfs (38 percent of median and below the normal range) in January. On the western island of Kauai, mean flow at the index station was above the normal range during November and December 1973, but decreased to less than median flow in January.

HYDROGRAPHS OF FOUR LARGE RIVERS


Columbia River at The Dalles, Oreg.
(Drainage area, 237,000 sq mi)
Missouri River at Hermann, Mo.
(Drainage area, 528,000 sq mi)
Ohio River at Louisville, Ky.
(Drainage area, 91,170 sq mi)
Potomac River near Washington, D. C.
(Drainage area, 11,560 sq mi)
DISCHARGE, IN THOUSANDS OF CUBIC FEET PER SECOND
Median
S O N D J F M A M J J A S O N D J F M A M J J A S O N D J F M A
1971
1972
1973
1974

BASIC DATA REPORTS ON QUALITY OF SURFACE WATER

The two water-supply papers listed below have been published within the past year by the Geological Survey. They supplement a listing of similar reports in the August 1973 issue of the Water Resources Review. Both water-supply papers contain data on chemical and biological quality, suspended sediment, and temperature of surface waters during the 1968 water year (October 1, 1967 through September 30, 1968). These data result from water investigations by the Survey, many of which are carried on in cooperation with State, Federal, and other cooperating agencies.

Each report is available for purchase at the price shown from the Superintendent of Documents, Government Printing Office, Washington, D.C. 20402.

Quality of surface waters of the United States, 1968, Parts 9 and 10, Colorado River basin and the Great Basin: U.S. Geological Survey Water-Supply Paper 2098, 296 pages, 1973. $2.35.

Quality of surface waters of the United States, 1968, Parts 12–16, North Pacific slope basins, Alaska, Hawaii, and other Pacific areas: U.S. Geological Survey Water-Supply Paper 2100, 464 pages, 1973. $3.05.

USABLE CONTENTS OF SELECTED RESERVOIRS NEAR END OF JANUARY 1974

[Contents are expressed in percent of reservoir capacity. The usable storage capacity of each reservoir is shown in the column headed "Normal maximum."]

Reservoir Principal uses: F–Flood control I–Irrigation M–Municipal P–Power R–Recreation W–Industrial	End of Dec. 1973	End of Jan. 1974	End of Jan. 1973	Average for end of Jan.	Normal maximum
	Percent of normal maximum				
NORTHEAST REGION					
NOVA SCOTIA					
Rossignol, Mulgrave, Falls Lake, St. Margaret's Bay, Black, and Ponhook Reservoirs (P)	52	55	66	54	223,400 (a)
QUEBEC					
Gouin (P)	91	76	59	61	10,865 ac-ft
Allard (P)	92	78	83	42	438 ac-ft
MAINE					
Seven reservoir systems (MP)	85	76	60	47	178,489 mcf
NEW HAMPSHIRE					
Lake Winnipesaukee (PR)	103	79	61	55	7,200 mcf
Lake Francis (FPR)	82	64	59	50	4,326 mcf
First Connecticut Lake (P)	90	63	43	36	3,330 mcf
VERMONT					
Somerset (P)	85	77	65	58	2,500 mcf
Harriman (P)	89	68	51	47	5,060 mcf
MASSACHUSETTS					
Cobble Mountain and Borden Brook (MP)	83	79	79	70	3,394 mcf
NEW YORK					
Great Sacandaga Lake (FPR)	63	57	60	44	34,270 mcf
Indian Lake (FMP)	86	68	48	53	4,500 mcf
New York City reservoir system (MW)	82	95	96	.....	547,500 mg
NEW JERSEY					
Wanaque (M)	88	95	101	75	27,730 mg
PENNSYLVANIA					
Wallenpaupack (P)	91	74	58	50	6,875 mcf
Pymatuning (FMR)	90	90	77	82	8,191 mcf
MARYLAND					
Baltimore municipal system (M)	94	98	102	84	85,340 mg
SOUTHEAST REGION					
NORTH CAROLINA					
Bridgewater (Lake James) (P)	89	91	90	77	12,580 mcf
High Rock Lake (P)	89	100	96	68	10,230 mcf
Narrows (Badin Lake) (P)	94	99	97	96	5,616 mcf
SOUTH CAROLINA					
Lake Murray (P)	85	85	80	61	70,300 mcf
Lakes Marion and Moultrie (P)	64	78	88	66	81,100 mcf
SOUTH CAROLINA--GEORGIA					
Clark Hill (FP)	61	71	70	55	75,360 mcf
GEORGIA					
Burton (PR)	72	75	81	55	104,000 ac-ft
Lake Sidney Lanier (FMPR)	61	63	59	51	1,686,000 ac-ft
Sinclair (MPR)	73	97	95	78	214,000 ac-ft
ALABAMA					
Lake Martin (P)	117	76	83	66	1,373,000 ac-ft
TENNESSEE VALLEY					
Clinch Projects: Norris and Melton Hill Lakes (FPR)	61	56	36	29	1,156,000 cfsd
Holston Projects: South Holston, Watauga, Boone, Fort Patrick Henry, and Cherokee Lakes (FPR)	51	53	46	54	1,452,000 cfsd
Douglas Lake (FPR)	24	16	13	12	703,100 cfsd
Hiwassee Projects: Chatuge, Nottely, Hiwassee, Apalachia, Blue Ridge, Ocoee 3, and Parksville Lakes (FPR)	46	53	49	40	512,200 cfsd
Little Tennessee Projects: Nantahala, Thorpe, Fontana, and Chilhowee Lakes (FPR)	52	61	53	46	745,200 cfsd
WESTERN GREAT LAKES REGION					
WISCONSIN					
Chippewa and Flambeau (PR)	73	39	52	41	15,900 mcf
Wisconsin River (21 reservoirs) (PR)	38	18	56	33	17,400 mcf
MINNESOTA					
Mississippi River headwater system (FMR)	33	28	19	20	1,640,000 ac-ft

Reservoir Principal uses: F–Flood control I–Irrigation M–Municipal P–Power R–Recreation W–Industrial	End of Dec. 1973	End of Jan. 1974	End of Jan. 1973	Average for end of Jan.	Normal maximum
	Percent of normal maximum				
MIDCONTINENT REGION					
NORTH DAKOTA					
Lake Sakakawea (Garrison) (FIPR)	89	85	90	.....	22,640,000 ac-ft
NEBRASKA					
Lake McConaughy (IP)	82	82	80	71	1,948,000 ac-ft
OKLAHOMA					
Keystone (FPR)	125	113	106	88	661,000 ac-ft
Lake O' The Cherokees (FPR)	112	99	109	77	1,492,000 ac-ft
Tenkiller Ferry (FPR)	114	107	112	87	628,200 ac-ft
Lake Altus (FIMR)	47	49	12	48	134,500 ac-ft
Eufaula (FPR)	110	98	103	81	2,378,000 ac-ft
OKLAHOMA--TEXAS					
Lake Texoma (FMPRW)	103	100	95	86	2,722,000 ac-ft
TEXAS					
Possum Kingdom (IMPRW)	84	81	90	76	724,500 ac-ft
Buchanan (IMPW)	82	82	73	77	955,200 ac-ft
Bridgeport (IMW)	52	52	52	41	386,400 ac-ft
Eagle Mountain (IMW)	98	98	92	84	190,300 ac-ft
Medina Lake (I)	100	100	94	47	254,000 ac-ft
Lake Travis (FIMPRW)	100	100	99	77	1,144,000 ac-ft
Lake Kemp (IMW)	59	60	43	75	319,600 ac-ft
THE WEST					
ALBERTA					
Spray (P)	67	51	67	43	210,000 ac-ft
Lake Minnewanka (P)	79	73	66	52	199,700 ac-ft
St. Mary (I)	58	65	70	62	320,800 ac-ft
WASHINGTON					
Franklin D. Roosevelt Lake (IP)	65	15	94	77	5,232,000 ac-ft
Lake Chelan (PR)	50	41	36	44	676,100 ac-ft
IDAHO--WYOMING					
Upper Snake River (7 reservoirs) (IMP)	66	73	73	68	4,282,000 ac-ft
WYOMING					
Pathfinder, Seminoe, Alcova, Kortes, Glendo, and Guernsey Reservoirs (I)	72	74	65	41	3,056,200 ac-ft
Buffalo Bill (IP)	51	48	67	65	421,300 ac-ft
Boysen (FIP)	92	89	67	68	802,000 ac-ft
Keyhole (F)	78	78	84	34	199,900 ac-ft
COLORADO					
John Martin (FIR)	4	5	4	18	364,400 ac-ft
Colorado--Big Thompson project (I)	84	82	72	54	722,600 ac-ft
Taylor Park (IR)	59	60	36	55	106,000 ac-ft
COLORADO RIVER STORAGE PROJECT					
Lake Powell; Flaming Gorge, Navajo, and Blue Mesa Reservoirs (IFPR)	72	70	53	.....	31,276,500 ac-ft
UTAH--IDAHO					
Bear Lake (IPR)	79	77	78	77	1,421,000 ac-ft
CALIFORNIA					
Hetch Hetchy (MP)	56	56	29	30	360,400 ac-ft
Lake Almanor (P)	92	101	66	44	1,036,000 ac-ft
Shasta Lake (FIPR)	77	87	76	70	4,377,000 ac-ft
Millerton Lake (FI)	65	86	78	63	503,200 ac-ft
Pine Flat (FI)	53	64	38	49	1,014,000 ac-ft
Isabella (FIR)	37	58	12	22	551,800 ac-ft
Folsom (FIP)	62	63	60	52	1,000,000 ac-ft
Lake Berryessa (FIMW)	97	103	88	83	1,600,000 ac-ft
Clair Engle Lake (Lewiston) (P)	95	103	83	80	2,438,000 ac-ft
CALIFORNIA--NEVADA					
Lake Tahoe (IPR)	76	83	69	51	744,600 ac-ft
NEVADA					
Rye Patch (I)	69	72	82	.....	157,200 ac-ft
ARIZONA--NEVADA					
Lake Mead and Lake Mohave (FIMP)	76	78	75	64	27,970,000 ac-ft
ARIZONA					
San Carlos (IP)	56	56	43	14	1,093,000 ac-ft
Salt and Verde River system (IMPR)	72	75	72	38	2,073,000 ac-ft
NEW MEXICO					
Conchas (FIR)	72	73	62	77	352,600 ac-ft
Elephant Butte and Caballo (FIPR)	32	36	16	28	2,539,000 ac-ft

[a]Thousands of kilowatt-hours.

METRIC EQUIVALENTS OF UNITS USED IN THE WATER RESOURCES REVIEW

(Round-number conversions, to nearest four significant figures)

1 foot = 0.3048 meter 1 mile = 1.609 kilometers
1 acre = 0.4047 hectare = 4,047 square meters
1 square mile = 259 hectares = 2.59 square kilometers
1 acre-foot (ac-ft) = 1,233 cubic meters
1 million cubic feet (mcf) = 28,320 cubic meters

1 cubic foot per second (cfs) = 0.02832 cubic meters per second = 1.699 cubic meters per minute
1 second-foot-day (cfsd) = 2,447 cubic meters per day
1 million gallons (mg) = 3,785 cubic meters = 3.785×10^6 liters
1 million gallons per day (mgd) = 694.4 gallons per minute (gpm) = 2.629 cubic meters per minute = 3,785 cubic meters per day

FLOW OF LARGE RIVERS DURING JANUARY 1974

Station number	Stream and place of determination	Drainage area (square miles)	Mean annual discharge through September 1970 (cfs)	January 1974					
				Monthly discharge (cfs)	Percent of median monthly 1941–70	Change in discharge from previous month (percent)	Discharge near end of month		
							(cfs)	(mgd)	Date
1–0140	St. John River below Fish River at Fort Kent, Maine.	5,690	9,397	6,263	223	-46	4,100	2,600	31
1–3185	Hudson River at Hadley, N.Y	1,664	2,792	3,822	216	-24	4,400	2,800	31
1–3575	Mohawk River at Cohoes, N.Y	3,456	5,450	8,855	193	-35	.....	.....	.....
1–4635	Delaware River at Trenton, N.J	6,780	11,360	18,980	185	-35	28,600	18,500	31
1–5705	Susquehanna River at Harrisburg, Pa.	24,100	33,670	65,310	216	-11	116,000	75,000	31
1–6465	Potomac River near Washington, D.C.	11,560	[1] 10,640	26,000	226	+8	22,000	14,200	31
2–1055	Cape Fear River at William O. Huske Lock near Tarheel, N.C.	4,810	4,847	7,800	149	+113	25,000	16,200	31
2–1310	Pee Dee River at Peedee, S.C	8,830	9,098	16,800	169	+110	19,900	12,900	30
2–2260	Altamaha River at Doctortown, Ga.	13,600	13,380	14,730	103	+127	16,200	10,500	28
2–3205	Suwannee River at Branford, Fla	7,740	6,775	3,870	93	+33	3,680	2,400	26
2–3580	Apalachicola River at Chattahoochee, Fla.	17,200	21,690	39,200	154	+160	52,200	33,700	29
2–4670	Tombigbee River at Demopolis lock and dam near Coatopa, Ala.	15,400	21,700	97,160	335	+134	92,000	59,500	28
2–4895	Pearl River near Bogalusa, La	6,630	8,533	48,000	594	+126	54,000	34,900	31
3–0495	Allegheny River at Natrona, Pa	11,410	[1] 18,700	38,510	173	+41	48,200	31,200	29
3–0850	Monongahela River at Braddock, Pa.	7,337	[1] 11,950	35,070	192	+38	22,400	14,500	29
3–1930	Kanawha River at Kanawha Falls, W.Va.	8,367	12,370	35,840	230	+54	39,000	25,200	27
3–2345	Scioto River at Higby, Ohio	5,131	4,337	13,570	359	+92	18,000	11,600	28
3–2945	Ohio River at Louisville, Ky[2]	91,170	110,600	328,100	224	+83	286,900	185,000	28
3–3775	Wabash River at Mount Carmel, Ill.	28,600	26,310	78,280	354	+104	142,000	91,800	31
3–4690	French Broad River below Douglas Dam, Tenn.	4,543	[1] 6,528	16,880	212	-6	.....	.....	.....
4–0845	Fox River at Rapide Croche Dam, near Wrightstown, Wis.[2]	6,150	4,142	3,500	101	-21	.....	.....	.....
4–2643.31	St. Lawrence River at Cornwall, Ontario–near Massena, N.Y.[3]	299,000	239,100	240,000	107	-11	220,000	142,200	31
5–0825	Red River of the North at Grand Forks N. Dak.	30,100	2,439	1,658	213	-9	1,620	1,000	31
5–3300	Minnesota River near Jordan, Minn ..	16,200	3,306	1,060	218	-50	950	600	29
5–3310	Mississippi River at St. Paul, Minn ...	36,800	[1] 10,230	6,790	145	-31	6,590	4,300	29
5–3655	Chippewa River at Chippewa Falls, Wis.	5,600	5,062	2,983	107	-23	.....	.....	.....
5–4070	Wisconsin River at Muscoda, Wis	10,300	8,457	6,487	115	-1	.....	.....	.....
5–4465	Rock River near Joslin, Ill	9,520	5,288	12,500	362	+42	28,500	18,400	31
5–4745	Mississippi River at Keokuk, Iowa ...	119,000	61,210	70,440	213	+6	125,700	81,200	31
5–4905	Des Moines River at Keosauqua, Iowa.	14,038	5,220	8,400	798	-26	14,000	9,000	31
6–2145	Yellowstone River at Billings, Mont.	11,795	6,754	2,959	115	-10	2,900	1,900	31
6–9345	Missouri River at Hermann, Mo	528,200	78,480	114,000	346	-9	257,000	166,000	28
7–2890	Mississippi River at Vicksburg, Miss.[4]	1,144,500	552,700	1,211,000	226	+14	1,397,000	903,000	28
9–3150	Green River at Green River, Utah ...	40,600	6,369	2,709	148	-2	2,600	1,700	28
9–4025	Colorado River near Grand Canyon, Ariz.	137,800	.....	14,500	.....	+153	.....	.....	.....
11–4255	Sacramento River at Verona, Calif ...	21,257	18,370	64,230	250	+11	66,200	42,800	28
13–2690	Snake River at Weiser, Idaho	69,200	17,670	22,230	149	+22	21,300	13,800	29
13–3170	Salmon River at White Bird, Idaho ..	13,550	11,060	9,297	221	+56	9,190	5,900	25
13–3425	Clearwater River at Spalding, Idaho ..	9,570	15,320	28,590	435	+134	44,600	28,800	29
14–1057	Columbia River at The Dalles, Oreg.[5]	237,000	194,000	244,500	218	+53	.....	.....	.....
14–1910	Willamette River at Salem, Oreg	7,280	23,370	78,180	147	-4	82,400	53,300	27–31
15–5155	Tanana River at Nenana, Alaska	27,500	24,040	5,439	250	-12	5,000	3,200	31
8MF005	Fraser River at Hope, British Columbia.	78,300	95,300	35,100	103	-13	37,600	24,300	30

[1] Adjusted.

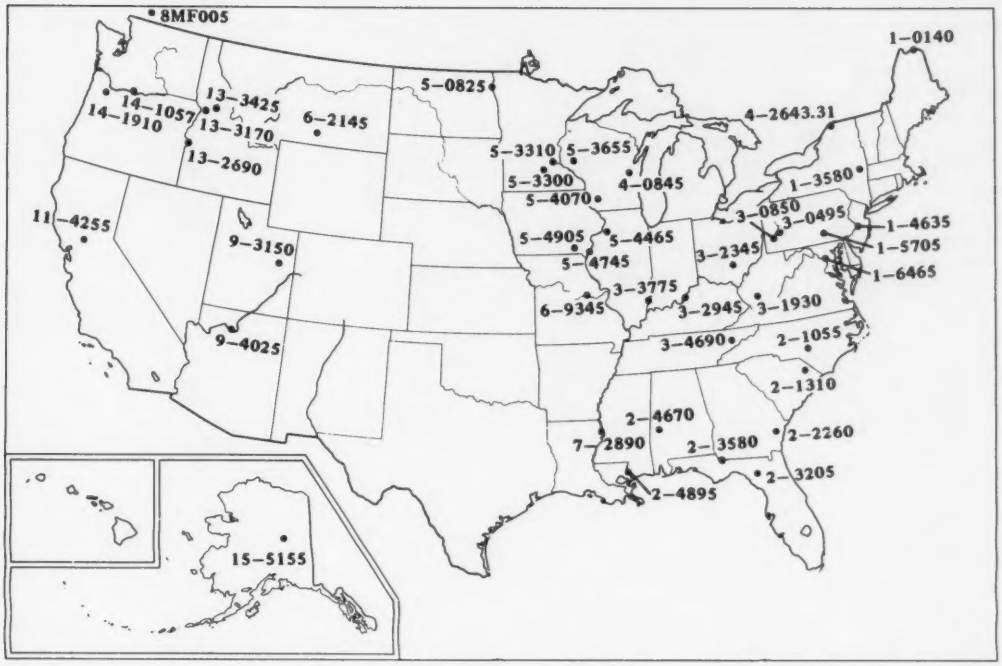
[2] *Records furnished by Corps of Engineers.*

[3] Records furnished by Buffalo District, Corps of Engineers, through International St. Lawrence River Board of Control. Discharges *shown are considered to be the same as discharge at Ogdensburg, N.Y. when adjusted for storage in Lake St. Lawrence.*

[4] Records of daily discharge computed jointly by Corps of Engineers and Geological Survey.

[5] Discharge determined from information furnished by Bureau of Reclamation, Corps of Engineers, and Geological Survey.

SELECTED STREAM-GAGING STATIONS ON LARGE RIVERS



Location of stream-gaging stations on large rivers listed in table on page 12.

WATER RESOURCES REVIEW — JANUARY 1974

Cover map shows generalized pattern of streamflow for January based on 22 index stream-gaging stations in Canada and 130 index stations in the United States. Alaska and Hawaii inset maps show streamflow only at the index gaging stations which are located near the points shown by the arrows.

Streamflow for January 1974 is compared with flow for January in the 30-year reference period 1931–60 or 1941–70. Streamflow is considered to be *below the normal range* if it is within the range of the low flows that have occurred 25 percent of the time (below the lower quartile) during the reference period. Flow for January is considered to be *above the normal range* if it is within the range of the high flows that have occurred 25 percent of the time (above the upper quartile).

Flow higher than the lower quartile but lower than the upper quartile is described as being within the *normal range*. In the Water Resources Review the median is obtained by ranking the 30 flows of the reference period in their order of magnitude; the highest flow is number 1, the lowest flow is number 30, and the average of the 15th and 16th highest flows is the median.

The normal is an average (but not an arithmetic average) or middle value; half of the time you would expect the January flows to be below the median and half of the time to be above the median. Shorter reference periods are used for the Alaska index stations because of the limited records available.

Statements about *ground-water levels* refer to conditions near the end of January. Water level in each key observation well is compared with average level for the end of January determined from the entire past record for that well or from a 20-year reference period, 1951–70. *Changes in ground-water levels*, unless described otherwise, are from the end of December to the end of January.

The Water Resources Review is published monthly. Special-purpose and summary issues are also published. Issues of the Review are free on application to the Water Resources Review, U.S. Geological Survey, Reston, Virginia 22092.

This issue was prepared by J.C. Kammerer, H.D. Brice, T.H. Woodard, and L.C. Fleshmon from reports of the field offices, February 11, 1974.

USE OF FINITE-DIFFERENCE ARRAYS OF OBSERVATION WELLS TO ESTIMATE EVAPOTRANSPIRATION FROM GROUND WATER IN THE ARKANSAS RIVER VALLEY, COLORADO

The accompanying abstract and figures are from the report, *Use of finite-difference arrays of observation wells to estimate evapotranspiration from ground water in the Arkansas River valley, Colorado*, by E. P. Weeks and M. L. Sorey: U.S. Geological Survey Water-Supply Paper 2029-C, 27 pages, 1973; prepared in cooperation with the U.S. Bureau of Reclamation, the Colorado Water Conservation Board, and the Southeastern Colorado Water Conservancy District. The report may be purchased for $0.50 from the Superintendent of Documents, Government Printing Office, Washington, D.C. 20402 (GPO Stock Number 2401-02451).

ABSTRACT

A method to determine evapotranspiration from ground water was tested at four sites in the flood plain of the Arkansas River in Colorado (fig. 1). Approximate ground-water budgets [for small plots of land] were obtained by analyzing water-level data from observation wells installed in five-point arrays. The analyses were based on finite-difference approximations of the differential equation describing ground-water flow.

Data from the sites were divided into two groups by season. It was assumed that water levels during the dormant season were unaffected by evapotranspiration of ground water or by recharge, collectively termed "accretion." Regression analyses of these data were made to provide an equation for separating the effects of changes in aquifer storage and of aquifer heterogeneity from those due to accretion during the growing season. The data collected during the growing season were thus analyzed to determine accretion.

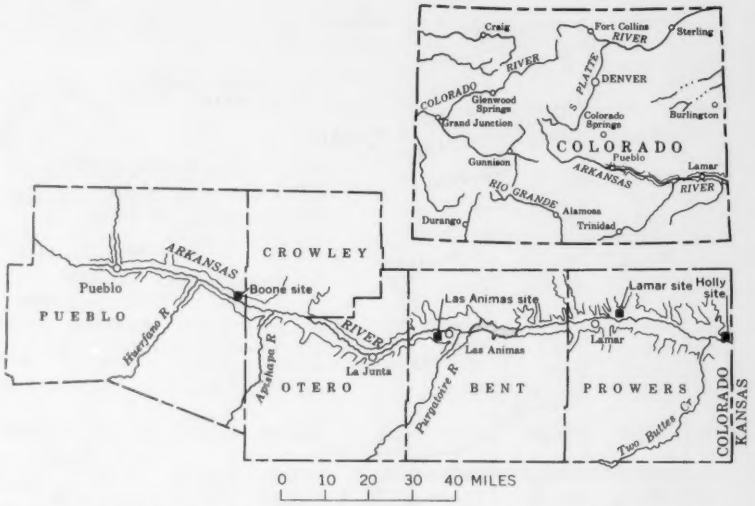


Figure 1.--Locations of sites where evapotranspiration from ground water in the Arkansas River valley in Colorado was estimated by finite-difference methods.

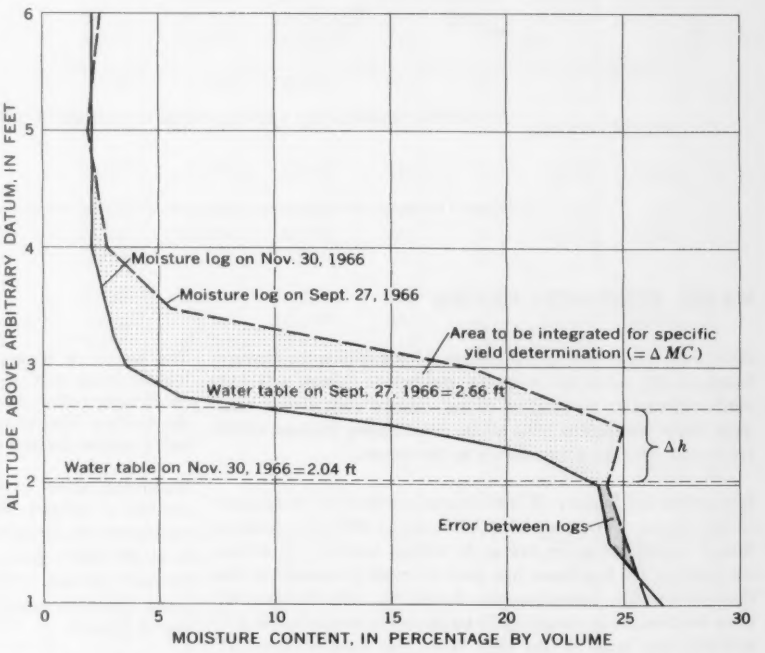


Figure 2.--Soil-moisture logs for the Lamar site on two dates showing a method for computing specific yield from changes in soil-moisture storage (ΔMC) and depth to the water table (Δh). Specific yield equals $\Delta MC/\Delta h$.

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